PRESERVATIVE TREATMENT OF WINDOW SASH AND OTHER MILLWORK

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How important is decay resistance in woods used for window sash? How important is it in frames, shutters, floors, and millwork in general? These items are not commonly destroyed by decay because the conditions under which they are placed are not favorable to deterioration. The average owner or occupant of a dwelling, store, or office building seldom encounters an instance of decay in the sash or interior woodwork of the building. On the other hand, every manufacturer of wooden window sash or frames and every carpenter who does repairing can point to numerous instances of replacement made necessary by decay.

The total number of wooden frames, sash, and shutters manufactured in a year is in the millions. No statistics on the number that show decay under ordinary use conditions are available; an expensive and time-consuming survey would be required to furnish a satisfactory basis for merely an approximate estimate. Probably, however, the percentage is small. Yet, although the number of instances of decay may be low, the matter cannot be ignored. It is far from immaterial to those who have to pay for expensive repairs caused by premature decay, and the manufacturer who loses the business or the good will of these displeased customers can hardly afford to consider it trivial. On the other hand, it is hard, without definite information as to the extent of the need, to justify any marked increase in cost of all sash and frames to protect the small percentage that may need it.

A factor of some importance is the modern trend towards air humidification and tighter window construction, especially in the colder parts of the country. Both favor the maintenance of higher humidities in buildings in the winter than have been customary in the past, which encourages the condensation of moisture on windows in cold weather and the collection of moisture in walls. It is reasonable, therefore, to expect an increase in the amount of trouble from decay as well as from sap stain in windows, beyond what has taken place in the past.[1]

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[1] In the northern part of the country the use of storm windows will often do much to reduce condensation on windows and the consequent danger of stain and decay. Weatherstripping is useful for reducing infiltration of air around windows but it does not keep the glass from becoming cold enough for condensation to gather. Storm windows, on the other hand, keep the inside panes of glass much warmer and cut down loss of heat through the windows. House owners should take care to see that they do not have excessive condensation on their windows. When cooking, bathing, or laundry work leads to condensation during cold weather, windows or doors should be opened sufficiently to ventilate the house or the room and carry out the excess moisture, even though a little more fuel may be required to keep the house warm.

In industrial buildings of certain types, where it is known from experience that sash and other woodwork will be subject to decay on account of the service conditions, there is no question that decay resistance should be provided. Experience has shown that the use of metal sash is not a satisfactory solution of this problem in industrial buildings where high humidities prevail, especially if there is any acid in the air, but wood sash thoroughly impregnated with a good preservative have been shown to be very durable in such places. All-heart sash of highly decay-resistant woods that are suitable in other respects may also be used successfully.

In the competition between wood and metal sash for dwellings and office buildings, lack of decay resistance in untreated wood sash is a sales disadvantage for wood that its competitors have not neglected, and the wood sash manufacturers can afford to make some attempt to overcome this obstacle. For this reason, as well as to reduce the number of cases in which decay or staining takes place, the treatment of all sash made from wood of low decay resistance has much to recommend it, providing it can be done effectively at moderate cost.

The Relative Decay Resistance of the Soft Pines

A question frequently asked is how the various pines now used for sash compare with one another in decay resistance. The question arises in part from the desire of the manufacturer and the user to know more about the subject, and in part, no doubt, from the conflicting claims made by the promoters of competing species. As a matter of general knowledge it would indeed be interesting to know just how Eastern white pine (Pinus strobus), Western white pine ("Idaho white pine," Pinus monticola), sugar pine (Pinus lambertiana), and ponderosa pine (Pinus ponderosa) compare with one another in average decay resistance. Since these woods, when untreated, are not ordinarily used in contact with the ground or in other places where conditions are known to favor decay, there are no adequate service records on which to judge them. Furthermore, there exists no fund of experience and general knowledge of their decay resistance such as that available on the woods more commonly used outdoors in fences, pole lines, and railroad and other engineering structures. Attempts have been made to work out laboratory methods for accurately comparing the decay resistance of different species but thus far none of the suggested methods has been found acceptable. It is impracticable, therefore, to set up a table of relative decay resistance for these species and defend it successfully, whatever one's personal opinion may be.

Heartwood and Sapwood

A well-known fact about all the commercial woods of the United States is that, under dry conditions, both the sapwood and heartwood remain free from decay but, under damp conditions, the sapwood is not resistant to decay, regardless of the durability of the heartwood. The sapwood of such

naturally durable species as redwood, cedar, and baldcypress rots quickly under conditions that favor decay and so does that of the pines and other species. Whether there is a measurable difference between the decay resistance of the sapwood of a species having highly durable heartwood, and the sapwood of one having less durable heartwood, has not been established but, even if a slight difference does exist, it is not enough to be significant. The outstanding fact is that, where decay resistance is required, no sapwood should be permitted unless it has been adequately treated with a preservative.

There are no restrictions on sapwood in lumber used for ordinary sash and frames. If used under conditions that are not conducive to decay, their life is not affected by the presence of the sapwood. Under conditions favorable to fungus growth, however, the sapwood invites early stain or decay, whether the heartwood is durable or not. So long as the practice continues of allowing unlimited amounts of sapwood in window sash and frames, there is little point to the debate over the relative decay resistance of the various pines that are now being used for those purposes. If a sapwood corner rots in a window sash or if the sash lift pulls out because of decay it is small comfort to the man who has to buy a new sash to know that the heartwood parts of the discarded sash are still sound.

A defect often encountered in sash and frames and chargeable to sapwood is the black or blue stain that develops when the wood takes up moisture and remains damp for considerable periods of time. It is merely a sap stain fungus growing after the installation of the finished article in the house instead of growing while the lumber was in a yard. The stain, when it occurs, is readily visible through varnish and frequently breaks through varnish or paint, to the discomfiture of the painter, who usually gets the blame. Since sap stains do not grow in heartwood, this defect is found only when sapwood is present and then only under damp conditions. Although these stains do not destroy the wood they may necessitate its removal on account of its appearance. They also indicate that conditions are favorable to decay and should be corrected.[2]

In addition to the staining caused by fungi that grow in the wood, molding or staining of the paint may occur that does not extend into the wood. Such staining cannot be attributed to the wood, but it is an indication that conditions are favorable for wood staining and decay and that they should be corrected.

Improvement Through Selection of Wood

A simple way to provide high decay resistance (although not necessarily the most practical or the most economical) is to make the sash,

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[2] Once the faulty condition has been corrected blue-stained sash may be safely repainted provided they are first given time to dry out thoroughly. It may be desirable to remove the old paint before repainting.

frames, or shutters out of naturally durable wood. The heartwood of certain species high in decay resistance can usually be counted on for long service even under conditions that favor decay. When questions of available supply, cost, appearance, working properties, and mechanical properties are taken into account, however, these species do not have undisputed superiority over the woods now commonly used for sash and frames.

Protection Through Painting

Contrary to popular belief, paints and varnishes are not effective in preventing decay. Wood used under conditions that favor decay can rot readily, whether it is painted or not. If paint could be relied upon to prevent the absorption of moisture and thus keep the wood always dry, decay would of course be prevented, for it is the presence of moisture in considerable quantity that permits decay. Wood that is well painted on all surfaces does absorb moisture more slowly than unpainted wood but the absorption is not prevented entirely and, if the exposure to dampness lasts long enough, the wood will become saturated and will swell as much as unpainted wood does. It is seldom, however, that wood is painted on all surfaces and moisture absorption is not retarded in the least through the unpainted surfaces. Moisture can usually find access also at joints, where the paint cracks because of repeated dimension changes in the wood or the working of the joints. Moisture that has found access to the interior of painted wood will evaporate more slowly than from unpainted wood. When this happens the paint may favor rather than retard decay.

Paints and other finishes do not prevent the development of blue stain. If conditions are favorable to the development of the blue staining fungi they grow, regardless of the paint that may be over them. If conditions are sufficiently favorable the staining fungi grow right through paint or varnish and repainting does not prevent their reappearance if the damp conditions are allowed to continue. Furthermore, as previously stated, fungi may grow in the paint itself and cause discoloration without reaching the wood.

Preservative Treatment

Preventing decay in wood by injecting toxic chemicals is easy. Preservatives and methods of treatment have long been available that can be relied upon to give to wood, even sapwood of low natural decay resistance, very long life under the most severe decay exposure. They will also prevent sap stain development. The problem of treating to meet the special requirements of wood for use in window sash, frames, and other millwork, however, is not so easy of solution. For example, no more effective preservative than coal-tar creosote is known, but it is obviously unsuitable for use in the windows or millwork of a house because both the color and odor of the creosote are objectionable, and creosoted wood cannot be satisfactorily painted or varnished.

Water-borne Preservatives

There are several good preservatives that can be injected in water solutions by pressure methods. Drying out the water after treatment leaves the wood clean, odorless, and paintable, although often changed in color to some extent. If the work is properly done and if the pieces in any way degraded by the treatment and subsequent drying are eliminated, the purchaser will receive a good product that is highly resistant to decay. It is quite possible to produce well-treated frames and sash in this way. The treatment is far from being as simple as it sounds, however, and the inconvenience and expense involved have prevented most sash and frame manufacturers from attempting to use water-borne preservatives.

Treatment of Lumber Before Milling

One procedure that may be followed in using water solutions is to treat the lumber by a pressure method before cutting it up and milling it. When this is done the lumber must obviously be completely penetrated and the preservative should be distributed through it uniformly. Spots of untreated or poorly treated wood in the interior of a board will almost certainly be exposed when the board is milled to finished size and shape, and under conditions favorable to fungus growth these vulnerable spots will be "welcome" signs to fungi. Complete penetration in sapwood pieces of most species up to 4 inches in thickness should offer little difficulty if pressure-treating equipment is available and proper treating conditions are used. Excellent treatment can readily be obtained, therefore, wherever it is possible to select for treatment lumber that contains no heartwood.[3] It is more difficult to obtain complete penetration in heartwood, but it is not impossible if the boards are not too thick. Considerable difficulty is likely to be encountered in completely penetrating heartwood pieces 2 inches thick or over. Different species of wood vary somewhat in the resistance of their heartwood to treatment but in practically none of them can the heartwood be considered easy to treat.

Treatment After Milling

Preservative treatment may be applied to the finished frames or sash after assembly, or to the individual finished pieces just before assembly. Both periods of application have the advantage that complete penetration is not necessary, for there will be little or no cutting after treatment. When using water solutions, however, treatment after assembly involves a number of difficulties. Injecting water into the wood will make it swell, probably causing, in consequence, either actual rupture of joints or at least compression severe enough to result in open or loose joints on subsequent

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[3] The superiority of heartwood over sapwood in decay resistance when untreated is of no significance in wood that is properly treated, for good preservatives properly injected prevent decay in both heartwood and sapwood.

drying. The checking and distortion that may develop in some of the assembled parts upon drying will waste more material than a similar amount of warping or checking in the rough lumber. Any joints containing glue may be seriously affected by the water and, furthermore, the surface of the wood may be so roughened that resurfacing will be required. Altogether, the outlook for the treatment of assembled sash with preservatives in water solution does not seem bright but, in some cases, it may be found practical. Treatment of the finished parts before assembly would not cause loose or open joints but grain raising, warping, checking, and drying problems would still be encountered. Undoubtedly, however, water-borne preservatives can be used to advantage under some conditions.

NSP Preservatives

NSP (nonswelling, paintable) preservatives are now available which consist of toxic chemical carried in nonaqueous volatile solvent with or without the further addition of water-repellent ingredients. These preservatives were developed to surmount the difficulties of using the water-borne preservatives. NSP preservatives of suitable character can be applied to woodwork after machining and surfacing, either just before or after assembly, without causing swelling, distortion, or roughening of the wood, without requiring careful redrying, without leaving objectionable odor, and without interference with subsequent painting or varnishing.

Various toxic chemicals have been used in preservatives of this type, including alphanitronaphthaline, betanaphthol, chlorobetanaphthol, chlororthophenylphenol, metallic naphthenates, pentachlorophenol, phenyl mercury oleate, and tetrachlorophenol. There may be other toxics that are as good or better. The relative merits of the toxics named have not yet been worked out satisfactorily, but the chlorinated phenols have found most extensive use. They are believed to be sufficiently effective provided they constitute not less than 5 percent of the treating solution by weight. If the preservative is sold in a concentrated form to be diluted before use, the 5 percent minimum applies to the solution after it has been diluted.

Since the toxics differ in cost, odor, solubility, and other properties, it is to be expected that, as knowledge about them increases through research and experience, some will be found more desirable than others. Considerable work in this field is being done by the Western Pine Association, which has published a number of formulas and has registered the name "Permatol" for them.[4] Some sash manufacturers and manufacturers of toxics

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[4] "Permatol" would be an appropriate general designation for all preservatives that do not cause wood to swell during treatment and leave the wood receptive of paints or other finishes. The syllable "Perm," however, has been incorporated in the trade names of several commercial products but not in the names of other equally suitable products of this nature. For that reason the National Door Manufacturers' Association's subcommittee on nomenclature and definitions has tentatively recommended the general designation "NSP," meaning nonswelling, paintable preservatives.

are also active in this work. Wartime problems have stimulated use of the NSP preservatives for wood products other than sash and millwork. Gradual change and improvement in the preservatives and extension of their use to other fields are to be expected for some years to come.

The NSP preservatives may well be divided into two types according to the presence or absence of water-repellent ingredients. Those without water repellent consist typically of a solution of toxic in volatile petroleum solvent such as mineral spirits or Stoddard's solvent and, in addition, may contain a proportion of less volatile solvent such as fuel oil, to facilitate spreading of the preservative through the wood structure and to prevent "blooming" (collection of crystals of solid toxic on the wood surfaces when the solvent evaporates). Other special solvents may be added to improve the solubility of the toxic and to prevent "sludging" (separation of ingredients from solution) while in dip tanks or in storage. Preservatives containing water repellents are discussed further on in this paper under the heading "NSP Water-repellent Preservatives."

The degree of effectiveness of the NSP preservatives in preventing decay, blue stain, and insect attack has not been sufficiently established. Laboratory experiments have indicated that they should give good protection if the wood is properly impregnated with a substantial quantity. Even the 3-minute immersion treatment, which is now commonly used with sash and similar items, appears to be giving good results in practice. It is believed, therefore, that the use of NSP preservatives is desirable for millwork that contains sapwood. Long continued observation and experience with treated sash under actual use conditions will be required, however, to determine the extent to which the promise of the laboratory experiments and limited experience is borne out in general service over long periods of time.

In order to choose intelligently among the various NSP preservatives it is important to know their composition. The term "wood preservative" is used very loosely by some makers of paint and varnish materials and there are products on the market which have been recommended for sash treatment that contain no toxic ingredients. Others may contain ingredients that are not sufficiently effective or that are present in insufficient quantity. Such materials cannot reasonably be expected to afford satisfactory protection against decay or stain. A secret formula leaves the purchaser without information as to the presence of a toxic ingredient, its nature, or the amount present in the solution, all of which are very important in considering the probable effectiveness of the material. Furthermore, the composition of a secret preservative may be changed at will by the manufacturer or seller, without the knowledge of the consumer. When the composition is disclosed, the purchaser has something definite for consideration, both as to cost and probable effectiveness, and he may also make occasional analyses or tests to determine whether the quality remains the same. Enough preservatives of known composition are available to make it unnecessary for anyone to purchase secret preservatives.

Importance of Good Treatment

Obviously, good treatment is needed, in addition to a good preservative, for even the best preservatives cannot give much protection if not properly applied. Although complete penetration is not required in treating finished parts, substantial penetration is necessary. Remarkable penetrating powers are not infrequently claimed for proprietary treating oils so that a brief dipping treatment is often said to be all that is required to give deep penetration with them. With a suitable preservative an appreciable amount of protection can no doubt be obtained by a few minutes submersion but better penetration and consequently better protection will be obtained by using longer soaking periods or more thorough treating methods. The National Door Manufacturers' Association recommends an immersion period of not less than 3 minutes. This is long enough to give a substantial degree of protection. Shorter periods are undesirable and longer ones are to be preferred.

Penetration of preservative must be deep enough to insure against exposure of untreated wood when the carpenter trims the frame or sash on installing it. Such exposure can be avoided by fitting the sash to the frame in the factory and treating after fitting. If the wood is sound to begin with, maintaining a substantial depth of treatment at all surfaces and in all joints will prevent decay of untreated wood that may be beneath. It is when the treated area is broken through by cutting or checking or by the opening of poorly treated joints that the untreated wood beneath can be reached by the fungus.

On account of the high volatility of most of the solvents employed in NSP preservatives, it is usually impractical to heat them. The effect of a hot-and-cold bath treatment can be accomplished by heating the wood in a properly controlled kiln and then submerging it and allowing it to cool in a tank of cold preservative. This method has been patented. A similar effect can be obtained by placing the sash in a closed container, drawing a vacuum, and admitting preservative without admitting air or applying additional pressure.

Since the solvents used with these preservatives are inflammable, proper precautions against fire or explosion must be provided where they are in use. After the treated material has dried thoroughly, however, it should be similar to untreated wood with respect to fire resistance.

Branding Treated Sash

Since the NSP preservatives are practially colorless, it is difficult and usually impractical to detect their presence in the wood after the sash have been in service some time. It is very desirable, therefore, that sash manufacturers place a permanent brand or identification mark on their products, giving the date and some mark to identify the preservative and method of treatment. This will permit failures to be traced to their sources and aid in pointing the way to improvements. It will also be of value in identifying products that give long and satisfactory service.

Treatment for Industrial Buildings

In certain types of industrial buildings, where the requirements for appearance are not too strict and where it is certain that high decay resistance is required, the thorough treatment obtainable only by treatment under pressure may be necessary to insure the long life that may be demanded. The purchaser, knowing the need for high decay resistance, is prepared to pay the cost of getting it. He may also wish to use only those preservatives whose value has been proved by long practical experience. Appreciable quantities of sash treated with water-borne preservatives have been installed in dye houses, textile mills, paper mills, and the like. In at least one case, the sash and frames in a locomotive roundhouse were creosoted and left unpainted. The result was considered much more satisfactory than that obtained with untreated wood or with metal sash.

NSP Water Repellents and NSP Water-repellent Preservatives

NSP water repellents are solutions that penetrate and spread in wood without causing it to swell and, upon drying, make the wood harder for water to wet and slower to absorb moisture and consequently swell, without interfering with subsequent painting or varnishing. The degree of retardation in absorption of water and swelling obtained with water repellents is much less than that attainable with good protective coatings of paint or varnish. The water repellents do not prevent decay or blue stain; in that connection they are subject to the limitations already discussed for paints and varnishes. The solvents used in many water repellents, however, are similar to those used in NSP preservatives and the water repellents share with these preservatives the property of spreading readily in wood after the initial penetration. It is therefore comparatively easy to convert such water repellents into NSP water-repellent preservatives by adding the necessary proportion of suitable toxic chemical.

NSP water-repellent preservatives have found considerable use in the last few years, not only in millwork but in other woodwork and in some military equipment and supplies. The extent to which the water-repellent property adds to the usefulness of the product, to offset a somewhat higher cost, has not been sufficiently established. For woodwork treated at the factory but not painted until it has been installed, the moderate degree of water repellency obtainable with water-repellent preservatives may furnish useful protection during the interval. Some woodwork that usually is left unpainted and is not fully exposed to the weather but may be subjected to moisture for brief intervals may profit from the water-repellent property.

Wood Sealers and Preservative Wood Sealers

Wood sealers, which are sometimes confused with water repellents, are essentially thinned varnishes or lacquers. Thin shellac varnish is one of the oldest wood sealers. Wood sealers resemble water repellents in that both products penetrate beneath the surface of wood but the water repellents

continue to spread still further into the wood whereas the wood sealers stay near the surface, promptly harden there, and, by nearly filling the openings in the wood cells, render the surface more or less impenetrable by the liquids in coatings of paint or varnish applied subsequently. The primary function of a wood sealer is usually to "prime" wood so that succeeding coats of paint or varnish will be "held out" and form continuous coatings over the surface. Wood sealers are used also to produce a decorative finish having much the same appearance as the old fashioned but very laborious rubbed linseed oil finish. Such finishes are in rather than on the surface of the wood.

When wood sealers are applied for the purpose of retarding changes in moisture content of wood, it has become customary to make two applications with time enough between for the first application to dry. With water repellents, on the other hand, one application is considered sufficient and, if more thorough treatment is desired, the time of immersion in the water repellent is increased or pressure is applied as discussed in the section entitled "Importance of Good Treatment." The moisture-excluding effectiveness of a single application of wood sealer is usually less than that of a good water repellent but a double application of wood sealer is often about equal to the good water repellents in effectiveness against moisture movement. The wood sealers do not preserve wood against decay or blue stain.

Preservative wood sealers are wood sealers to which preservative chemicals have been added. Some of the oil-soluble toxics used in NSP preservatives may be used also in preservative wood sealers provided that the toxic does not interfere with the drying of the wood sealer. The phenols, when present in the concentration necessary for preservation, may tend to retard the drying of sealers. Phenyl mercury oleate is less likely to retard drying and is used in a number of sealers now on the market, usually in a concentration of 1/2 to 1-1/2 percent by weight instead of the minimum of 5 percent considered necessary with the chlorinated phenols.

Since the preservative wood sealers do not penetrate much beneath the surface of wood, they are not considered so effective as the NSP preservatives or water-repellent preservatives in protecting wood against decay or blue stain. Where the object is merely to prevent growth of molds on the surface (mildew), however, the preservative wood sealers may accomplish the purpose satisfactorily.

Specifications for Sash Treatment

Standard specifications covering acceptable preservatives and methods of treatment for sash and similar products have been prepared by the National Door Manufacturers' Association and have been in use for some years.

Use of NSP Preservatives on Other Products

Although the foregoing discussion has been limited mainly to sash and frames it has general application to other products, including shutters, flooring, finish lumber, garage and other outside doors, automobile body parts, refrigerator parts, partitions, office equipment, and furniture, when they are to be used under conditions that require resistance to decay or insects. Under the conditions that ordinarily prevail in buildings throughout most of the United States, no preservative treatment is required for floors, partitions, interior finish, lumber, or furniture, but it may be required in special cases or for use in warm humid climates, when it is known in advance that service conditions will be severe.

Moderate resistance to termites, as well as decay resistance, can be obtained by the use of heart redwood or heart baldcypress in products for which these woods are suitable. For other products or for other American woods, or where maximum termite and decay resistance is required, preservatives should be used.

With wooden refrigerator parts, and with any other wood that is to be used in close proximity to food, especial consideration must be given to avoiding odor and contamination. Toxic chemicals that endanger health must be avoided in treating wood that is handled frequently, or that will be used in interiors of buildings.

Results to be Expected

It is not possible to predict with certainty the number of years of additional service that can reasonably be expected from treatment of sash and similar products. The conditions of service have much to do with the result. Thorough impregnation with coal-tar creosote under pressure, resulting in absorptions of 12 pounds of creosote or more per cubic foot of wood should give complete decay protection to sash, doors, and similar products throughout their mechanical life or the useful life of the building in which they are installed. Creosote treatment, however, is seldom acceptable for such products.

Thorough pressure treatment with reputable water-borne preservatives should give about the same results as creosoting in situations where the wood may be damp but will not be exposed to the leaching effect of constant or frequent contact with free water. Where service conditions favor leaching, water-borne preservatives will be less effective than creosote.

The NSP preservatives containing not less than 5 percent of a stable and suitable toxicant have not been in use long enough to have shown by their performance in actual service just how they compare in effectiveness with creosote and water-borne preservatives. Laboratory tests and such limited service tests as are available, however, indicate that they should give satisfactory results. It is reasonable, on the basis of the information

thus far available, to expect these preservatives to give satisfactory protection when they are thoroughly impregnated into wood in substantial quantities.

Most sash and similar products are not used under the most severe service conditions, and consequently they do not require the heavy treatment necessary for outdoor structural timbers. Simple immersion for 3 minutes or longer in NSP preservatives of high quality is probably sufficient to prevent decay in sash in ordinary homes and office buildings, if the treated wood is not trimmed off in subsequent fitting operations. Where conditions are very favorable to rapid decay or stain, more thorough impregnation is considered necessary for adequate protection.

Dipping for a few seconds in any preservative gives only a slight degree of protection and is not considered adequate for general use.